EX PARTE OR LATE FILED

RECEIVED

FEB 5 - 1992

Federal Communications Commission
Office of the Secretary

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Advanced Television Systems	)	
and Their Impact upon the	)	MM Docket No. 87-268
Existing Television Broadcast	)	
Service	)	

EX PARTE FILING
UNITED STATES ADVANCED TELEVISION SYSTEMS COMMITTEE
(ATSC)

The United States Advanced Television Systems Committee (hereinafter "ATSC") hereby files an ex parte presentation related to this Docket. An original and two copies of this presentation are hereby submitted for inclusion in the record in this proceeding.

The ATSC filed Comments on December 19, 1991. Section 8 of the ATSC Comments (Compatibility with Other Media) stated, "The ATSC continues its studies in these areas and will distribute pertinent findings and recommendations to the Advisory Committee and the Commission as well as to proponents of terrestrial ATV systems and other interested parties."

The ATSC Technology Group on Distribution released a new document "Digital Audio and Ancillary Data Services for an Advanced Television Service" on February 3, 1992. This paper would have been included in the ATSC Comments as an annex had it been available at the time of our original filing. The document is attached. ATSC will continue to keep the Commission informed of its relevant studies.

Respectfully submitted,

United States Advanced
Television Systems Committee
1776 K Street, NW, Suite 300
Washington, DC 20006

James C. McKinney
Chairman

February 5, 1992

No. of Copies rec'd 0+2
List A B C D E

Doc. T3/186
03 Feb 1992

DIGITAL AUDIO AND ANCILLARY DATA SERVICES

FOR AN

ADVANCED TELEVISION SERVICE

Advanced Television Systems Committee

Technology Group on Distribution

Table of Contents

Executive Summary

The Specialist Group on Digital Services (T3/S3) of the Technology Group on Distribution (T3) of the Advanced Television Systems Committee (ATSC) has been working for two years to identify the digital audio and data services that should accompany the Advanced Television (ATV) picture. T3/S3 has conducted technical studies and industry surveys, and has circulated a "strawman" proposal to stimulate industry discussion and feedback. Based on this work, T3 offers the guidance contained in this document. On February 3, 1992 the ATSC Executive Committee approved release of this material. It is hoped that the ATV system selected for use in the United States for terrestrial broadcasting, as well as ATV systems for the alternative media, will follow this guidance.

A major finding is that it is not desirable to select a fixed set (number and type) of digital audio and data services for inclusion into the 6 MHz ATV channel. This is because the data rate required for all potential services would negatively impact the picture data rate and affect the picture quality. It is recommended that the ATV system allow data to be allocated to digital audio and data services only on an as-needed basis. A flexible system of data allocation will require the use of only the minimum data capacity necessary for digital audio and data services at any time. Flexible allocation also allows the addition of new types of digital services in the future, with older receivers ignoring the new data types.

The ATV service will offer widescreen pictures, and this feature is expected to increase consumer interest and enjoyment of this new format. The audio corollary to the wider aspect ratio is multi-channel audio. Recognizing the significant limitations of two-channel stereophony for sound accompanied by pictures, it is recommended that the ATV service be capable of delivering five channel audio (left, center, right, left surround, and right surround). This is generally consistent with recent trends in the application of digital audio in the motion picture industry, and the draft recommendation from CCIR Task Group 10/1. Recent advances in multi-channel audio coding technology have reduced the data rate required for five-channel audio nearly to that required for two independent audio channels. All ATV receivers would need to decode the provided service (which could vary from one to five channels) into the number of loudspeaker channels to be used (e.g. the five-channel audio service may be decoded into mono for the low-cost mono receiver).

The ATV audio system should provide a solution to the problem of loudness uniformity among programs, channels, and delivery media. The average perceived loudness of dialogue should be uniform. The coded audio data should indicate the average dialogue loudness within the dynamic range of the coding system. Different programs may have varying amounts of headroom above this level which is available for dramatic effect.

The ATV audio system should allow audio service to be provided with a wide dynamic range. Since experience indicates much of the audience will prefer a restricted dynamic range, the audio coding system should incorporate an integrated dynamic range compression system. Information about the compression introduced may be incorporated into the audio data stream so that the receiver may optionally reverse the compression to restore the original dynamic range of the program.

The ATV system should allow service to be delivered to the visually and hearing impaired. The visually impaired may be served by an optionally allocated narrative audio channel. The hearing impaired may be served by the captioning system, or by an optionally allocated audio channel containing only dialogue which has been processed for improved intelligibility.

Flexible allocation of data capacity to audio allows audio service to be optionally provided to specialized audiences, including those with other languages. Audio services should be tagged to indicate language and type, so that the receiver may assume the burden of choosing the correct language audio service for the viewer (assuming the receiver has knowledge of the viewers preferred language), and so that the viewer may determine the types of audio available.

1. Introduction

1.1 Background

The Advanced Television Systems Committee (ATSC) and many other organizations, both public and private, have recognized that most of the effort spent on Advanced Television (ATV) standardization has been put into the development of the vision signal encoding schemes, and that it is important that appropriate emphasis be put on defining the accompanying sound channels, the features of the ancillary data and control services, and the way these digital services should be included in the ATV transmission format. The ATV spectrum will be efficiently utilized making it difficult to add additional services into unused portions of the signal as was done with NTSC transmissions, where services such as color, BTSC multi-channel sound, Teletext, and Closed-Captioning were added long after the NTSC standard was set. Only by anticipating and providing for all needed services from the beginning of the ATV service, or by leaving a means for extending the set of provided services in a compatible manner, can the needs of the future be accommodated. In order to provide some leadership on these issues, the ATSC Technology Group on Distribution (T3) formed a Specialist Group on Digital Services (T3/S3). The charter of T3/S3 directs it to conduct technical studies and industry surveys, in order to develop technical information on audio and ancillary data services. T3/S3 has been working since January of 1990 to identify the necessary data services and their required data rates. In December of 1990 a "strawman" proposal was developed. The strawman was widely circulated during the first half of 1991. Industry response to the strawman, and discussions within T3/S3, have led to the recommendations in this document. The results of the T3/S3 studies indicate that an acceptable set of audio and ancillary services can only be provided by a flexible, extensible system which allocates data capacity to these services only on an as-needed basis. All remaining data capacity should be used by the video system for improved picture quality.

1.2 Goal

The goal of this work is to provide guidance on the characteristics of the digital services (other than video) which are provided by the ATV system selected for use for terrestrial broadcasting in the United States. Specifically, T3 suggests that the ATV system selected for terrestrial broadcasting and the alternative media follow the guidance in this document.

1.3 Scope

This document contains the suggestions of T3 as to the characteristics of the audio and digital services which should be provided by an ATV system adopted for use in the United States, both for terrestrial broadcasting and by the alternative media. Many services are identified which the programmer may provide in a standardized manner. Standardization of services is necessary so that receiver manufacturers may produce receivers that can receive these services. Some desirable practices are described and recommended for use. Definition of all aspects of the audio and data services has not been attempted, since many details will depend on the characteristics of the ATV video, multiplexing, modulation, and error correction systems which are adopted for use. The implementation details will have to be worked out with the designers of the ATV system which is selected for use in the United States.

1.4 Definitions

The following terms are defined as used in this document:

Contribution Link
A signal path which is used to convey elements of a program to the point where they are combined to produce the finished program.

Distribution Link
A signal path which is used to convey a completed program to the point of delivery to the viewer.

Delivery Link
The final signal path to the viewer.

Delivery System
The coding system for video, audio, and data services used over the delivery link.

Programmer
The originators of the delivery signal, including terrestrial broadcasters, cable television systems, and sources of pre-recorded media.

Alternative Media
Signal paths to the viewer other than terrestrial broadcast, including electrical and optical cable, satellite, disc and tape.

Service
A pathway from the programmer to the viewer, through which data for some function is delivered. The term channel could be used, except that there can be confusion between audio channels, television channels, and other uses of the term channel.

Audio Service
A single, possibly multi-audio-channel, pathway from the programmer to the viewer intended to be reproduced alone, or in combination with other audio services, to make a complete ***audio program***.

Audio Program
A complete assemblage of audio to be reproduced as a whole by the viewer. A program is composed of one or more ***audio services***. The viewer may have the option of selecting which services to combine to form the complete program.

Independent Coding
A method of low bit-rate audio coding where a fixed data capacity is used for a single audio channel.

Composite Coding
A method of low bit-rate audio coding where a fixed data capacity may be shared amongst a number of audio channels intended to be reproduced together.

Data Service
A pathway for data with a specific purpose, such as teletext or conditional access control.

HI: Hearing Impaired

An audio service providing dialogue which has been processed for improved intelligibility, intended for use by those with impaired hearing.

VI: Visually Impaired

A narrative or commentary service carrying descriptive information regarding the picture, intended for use by those with impaired vision.

Viewer

The recipient/user of the ATV program, whether viewing the picture or not.

L_{Aeq}

A measure of A-weighted sound pressure level which is an average over time. L_{Aeq} is precisely defined in IEC 804. L_{Aeq} is measured with an integrating sound level meter.

Loudness Meter

A measuring device based on psychophysical principles which indicates the magnitude of sound as perceived by a typical listener.

1.5 Major Principles

1.5.1 Flexible Allocation

The number and type of audio and data services which an ATV system should deliver will vary significantly depending on what services are available to accompany the picture, and the needs of the particular service area for the delivered program. In order to provide a maximum level of utility, many audio channels and data services might be needed. A fixed provision for many audio channels and data services would require that a significant portion of the available transmission capacity be reserved for these services. This would unnecessarily constrain the video quality, which would suffer if its available data rate were restricted. Since much of the programming will not require many audio channels or data services, a fixed allocation of transmission capacity to these services would be inefficient. Therefore, the ATV transmission system should be capable of a flexible allocation of data to audio and data services on an as-needed basis, consistent with the data capacity required for the video system. At the point of delivery a choice may be made based on the available services and the needs of the intended audience as to which services are to be delivered. Note that the distribution signal may contain more or less audio and data services than the delivery signal, since the programmer will determine the exact mix of services to supply to the local audience. For instance, the distribution signal may contain audio in several languages, only some of which are pertinent to any given service area. The programmer in that area should be free to choose which of the available languages to provide to the local audience. Conversely, the local programmer may choose to insert additional services prior to delivery.

1.5.2 Extensibility

It is not possible to envision and provide for all potential audio and data services which might be useful components of the ATV service in all media. It is feasible to allow new digital services to be added in a compatible manner by means of the flexible allocation of data capacity. The key is to provide a way to identify new types of allocated data services, so that new or upgraded receivers may make use of the new data types, while older receivers simply ignore them. The new data types could offer new kinds of audio services (perhaps with more audio channels) and new kinds of information

services. Some of the additional data types could be intended for private or commercial reception, with the data capacity being sold by the programmer to provide a supplemental revenue source.

1.5.3 Service Identification Data - SVID

The ATV digital services system requires a method of ideatifying the services that are being provided so that the receiver may know how to make use of them. There are a number of methods (packets with descriptive headers, stream of descriptive packets at a fixed location in the multiplex, etc.) which can supply the Service Identification Data (SVID). This issue has not been studied and no recommendation is made as to the optimum method. Whatever method is employed should allow the identification of the pre-defined audio and data services, as well as future as-yet undefined services.

1.5.4 Multi-Channel Audio

The ATV system should be capable of delivering multi-channel sound appropriate to the wider, higher definition picture. Consistent with demonstrated psychoacoustic principles, the preferred channel assignment is: Left, Center, Right, Left Surround, and Right Surround. [Note: This is consistent with the CCIR Task Group 10/1 Draft Recommendation on Multi-Channel Sound, and the SMPTE Film Sound Sub-Committee Report]. An optional low bandwidth channel for low-frequency enhancement (subwoofer channel) may also be provided. Monophonic and two-channel stereophonic transmission modes of operation should also be provided, and will offer the most efficient method of delivery for mono or two-channel stereo programming.

Even with the use of advanced low bit-rate audio coding technologies, provision of five high quality independently coded discrete channels would require significant data capacity. However, recent developments in composite (see definition) multi-channel audio coding technology show that five-channel audio may be delivered with a data rate only slightly larger than that required by two high quality independently coded channels. It is recommended that a five-channel composite coding mode be pre-defined as part of the ATV system. An audio service with more than five channels could be defined in the future by allocating additional data to such a service using the principle of extensibility.

It is preferable that audio programs not be simultaneously provided by a monophonic or two-channel stereophonic service intended for low cost receivers, and a separate multi-channel service intended for high end receivers. That would be wasteful in data capacity, and would inhibit the use and growth of multi-channel audio. It would be necessary, though, that all receivers be capable of decoding a multi-channel service into the desired number of reproduction channels. Lower cost receivers would not need to completely decode all five channels, but could decode the five channel service into a conventional monophonic or two-channel stereophonic program with attendant cost savings.

1.5.5 Multiple Languages

The ATV audio system should be able to provide programming simultaneously in multiple languages. The programmer may allocate additional audio services for this function, and may use the captioning system for subtitles. The operational complexity for the viewer (compared to the present BTSC/SAP system) can be reduced by tagging each audio service with language identification information. The viewer could simply inform the receiver of the preferred language, and the receiver could select the appropriate audio service when available. Another mode of operation that can be offered is to simultaneously provide a foreign language program in its original language with subtitles available, as well as dubbed into the main language.

1.5.6 Audio Services to the Visually and Hearing Impaired

The ATV audio system should allow programmers to deliver special audio services to the visually impaired (VI) and hearing impaired (HI) using the flexibly allocable channels. The VI service would typically contain a narration describing the picture content, and would be reproduced along with the main audio program in the receiver. The HI service would typically contain only dialogue, and would be processed for improved intelligibility.

1.5.7 Uniform Loudness

The ATV audio system should provide the means to control loudness in a uniform manner among various programs and delivery channels. The viewer should perceive the same subjective dialogue loudness when a program ends and a new program begins, or when channels are changed. Loudness uniformity should not be accomplished by processing all audio to peak at 100% level as is commonly done with NTSC programs. Rather, audio programs should use a dialogue reference level for normal spoken dialogue. The ATV audio data should inform the receiver of this level so that the receiver can reproduce the normal spoken dialogue at an acoustic level chosen by the viewer. By the choice of reference level, program providers may select the headroom above reference level which is available for dramatic effect. The headroom available may thus vary from program to program. Compliance with uniform dialogue loudness should be enforced voluntarily by the industry. Dialogue loudness should be measured with a loudness meter.

1.5.8 Dynamic Range Control

There is a conflict between the needs of many viewers for program audio to have a narrow dynamic range, and the desires of some viewers to reproduce the audio in the full dynamic range intended by the program producer. The ATV audio coding system should incorporate an integrated dynamic range compression method which delivers data to the receiver representing the compression characteristic employed. The preferred compression method will bring loud sounds down towards the dialogue level, and quiet sounds up towards the dialogue level. Programmers are encouraged to use this system when the dynamic range of audio programming is intentionally restricted beyond that inherent in the source program material.

Receivers may include circuitry which gives the viewer the ability to control the reproduced dynamic range. Using the data representing the compression characteristic employed, the receiver may partially or completely reverse the dynamic range compression intentionally introduced by the program provider.

1.5.9 Ancillary Data Services

Several types of data services should be pre-defined. Others may be added using the flexible allocation capability. Some types of data services, such as conditional access, may only be used by the alternative media.

1.5.10 Programmer Control of Audio and Ancillary Data Services

From the point of origination, the program may be distributed to a multiplicity of delivery sites. The originating site may choose audio and data services to distribute to the delivery sites. The programmer may then choose which of the distributed audio and data services to actually deliver. At each point in the chain, (i.e. network distribution, local delivery) the choice can be made to eliminate services which are not appropriate to the intended audience or to add services which are useful.

1.5.11 Error Correction and Concealment for Audio Services

It is recognized that error correction and concealment is a more critical issue for an audio service than for the video service, as reproduced audio errors may be more annoying than reproduced video errors. In addition, some types of delivery (terrestrial, DBS, etc.) will be used by some viewers at the threshold of the service area. Therefore, the ATV audio system should include effective concealment methods to minimize audible disturbances caused by uncorrectable errors.

1.5.12 Monitor Electro-Acoustic Frequency Response

It is recognized that a standardized monitor electro-acoustic frequency response promotes better interchangeability among programs. To this end, a production standard should be in place, such as SMPTE 222M (currently being revised). (Note that programs already produced using other monitor electro-acoustic frequency responses, such as film and television programming, made using curve N or curve X of SMPTE 202M or ISO 2969, will need appropriate frequency response correction.)

2. Service Identification Data (SVID)

Service Identification Data (SVID) should be incorporated into the ATV data stream. The SVID supplies descriptors[1] for all digital services delivered by the ATV signal. The descriptors identify the digital services and indicate their locations within the overall data multiplex. Several methods may be used to deliver this information (such as packets with headers) providing they meet the requirements for this function. This issue has not been studied and no recommendation is made as to the technique to be employed.

The SVID should be very reliable, since errors could cause total loss of ATV service. The SVID should be recognizable by the receiver as soon as possible after a channel change. The information carried by the SVID should be repeated frequently, so that a receiver can quickly recognize the available services after a channel change, and so that the redundancy can be used to improve reliability of the data. The format that is adopted for the SVID should be very flexible and allow new digital services to be defined and delivered in a manner that is compatible with all ATV receivers.

3. Audio Services

3.1 Audio Coding Modes

The ATV system should support the pre-defined audio coding modes for audio services as described below. The coding modes are broken down into two categories: independent coding and composite coding. The independent coded modes code a single audio channel into an independent data stream. Independently coded channels are typically used for monophonic services, and may be used in pairs for two-channel stereophonic services. The composite coding modes code multi-channel audio programs into a composite data stream, and achieve greater coding efficiency as the number of audio channels increases. With composite coding, all of the audio channels which have been coded into the composite data stream must be reproduced together (similar to the way the R,G,B colors must be reproduced together to form the viewed picture), although not necessarily out of independent loudspeakers. The channels may be mixed together to reduce the number of loudspeakers required for reproduction.

The programmer may utilize any of the audio coding modes. The choice of mode will be determined by the programming, its intended audience, the value placed on the data capacity utilized, etc. Programs

---

[1] Work is on-going in the Society of Motion Picture and Television Engineers (SMPTE) concerning the precise definition of headers/descriptors.

with monophonic or two-channel stereophonic sound may utilize only one or two audio channels of a multi-channel mode, or may use one or two independently coded channels. Up-conversion or special processing of archived mono or stereo program material is not necessary.

In order to produce sound, the receiver must be able to decode all of the pre-defined coding modes. Since the audio decoding hardware for the 3/2 mode is capable of decoding all of the other modes, this incurs no receiver cost penalty.

The data rates shown for the various modes are estimates, and are derived from comments from industry companies and organizations. These estimates have not been verified and no specific coding system is recommended. The data rates shown include all information for the service including coded audio data and associated audio data (see section 3.1.3), but exclude overhead for error correction.

3.1.1 Independent Coding Modes

There are three independent coding modes, which provide varying levels of audio quality vs. bit-rate. The bit rates shown are per individual audio channel.

High Quality	128 k bits/sec
Medium Quality	96 k bits/sec
Low Quality	64 k bits/sec

3.1.2 Composite Coding Modes

There are three composite coding modes, which offer different numbers of audio channels with corresponding bit-rates. The numerical designations indicate the number of front channels / rear channels. Some audio coding technologies incorporate a low bandwidth channel (<200 Hz) intended to deliver low-frequency enhancement information (subwoofer channel), the use of which would be optional for the programmer, receiver, and viewer.

3/2	300 to 400 k bits/sec
3/0	256 k bits/sec
2/0	192 k bits/sec

3.1.3 Associated Audio Data

Besides the actual coded audio, the audio data stream for each audio service may convey several other types of information.

3.1.3.1 Headroom

The level of dialogue within the dynamic range of the digital audio coding system is not pre-defined. The headroom available is defined as the difference between a long-term average (L_{Aeq}) of dialogue level and the sine wave clipping level of the digital audio system at 1 kHz. This headroom value is included within the audio data. The ATV receiver should use this information in order to reproduce different programs at the same dialogue level.

3.1.3.2 Dynamic Range Control

The program provider may intentionally restrict the dynamic range of the audio program. If so, the data representing the compression characteristic may be incorporated into the audio data

stream so that the receiver may optionally, completely or partially, restore the original dynamic range. The capability to recognize this information and restore the dynamic range should be receiver optional.

3.1.3.3 Descriptor Information

Information for each audio service is required for the SVID. Some of this information is contained within the coded audio service data stream and may be extracted by the ATV system multiplexer and placed into the SVID. Other information (such as the location of the audio service data within the overall multiplex structure) is unknown to the audio coder and thus cannot be contained in the audio service data. Data intended for the SVID includes items such as language and the audio coding mode employed.

3.1.3.4 User Bits

A small amount of data capacity may be used to convey any sort of audio related information which is found useful by the programmer. An example use for the user bits would be indication of the monitor loudness used in the production of the audio program (which allows the viewer to reproduce the audio at the same volume level at which it was mixed).

3.2 Usage of Audio Services

The following sections indicate ways in which the programmer may use the audio coding modes to deliver audio services and programs. Individual audio services may deliver complete audio programs, or complete or enhanced programs may be constructed from more than one audio service. A service capable of delivering a certain number of audio channels may be used to deliver a fewer number of channels, with some channels not loaded. (While less efficient in data rate, this might be done to eliminate frequent service reconfigurations.)

3.2.1 Complete Program from an Individual Service

All elements of the audio program are present within the service, although additional audio services (such as VI or HI) intended for use with the complete service may be available.

3.2.1.1 3/2 Multi-Channel Program

When surround information is relevant and available, the 3/2 composite coding mode is preferred. Three front channels and two surround channels are provided.

3.2.1.2 3/0 Multi-Channel Program

When surround information is not available, the 3/0 mode is most efficient. Three front channels are provided. The 3/2 mode may also be used.

3.2.1.3 2/0 Stereophonic Program

Two-channel stereophonic audio may be most efficiently transmitted with the 2/0 mode. The 3/2 or the 3/0 modes may also be used. The 2/0 mode may be suitable for delivery of existing four-channel matrix surround encoded programming. (More work is required to verify this.)

3.2.1.4 Monophonic Program

Monophonic audio may be delivered using either the high, medium, or low quality independent coding modes. Mono may also be delivered using the 3/2, the 3/0, or the 2/0 (left and right both contain the mono program) modes.

3.2.2 Complete Program from Multiple Services

The following examples show how a complete audio program may be delivered using a combination of audio services.

3.2.2.1 Two-Independent-Channel Stereophonic Program

While a 2/0 composite coding mode is defined for delivery of two-channel stereophonic material, it is also possible to use two independently coded services to deliver the left and right channels. The independently coded services may use either the high, medium, or low quality coding modes. Both the left and right channels must use the same independent coding mode. This method of delivery is suitable for the delivery of four-channel matrix surround encoded programming.

3.2.2.2 Program for the Hearing Impaired

Some viewers with impaired hearing could enjoy the audio program if the dialogue were reproduced without music and effects. The non-dialogue elements (music and effects) of the sound interfere with dialogue intelligibility. In order to serve the HI viewer, it is necessary to deliver a dialogue only HI service. Since the HI service is missing important elements of the program, the HI listener might wish to mix some of the main program audio in with the HI audio to make a complete program. The mixing ratio would need to be under the control of the HI viewer, since it would depend on the degree and nature of the hearing impairment, and personal preference. In this case the receiver would decode the (possibly multi-channel) main program audio service, and the HI service, and mix the two together for the viewer. The receiver may optionally apply dynamic range compression to the main audio before it is added to the HI audio. Further work is required to verify the practicality of adding a processed dialogue audio channel into the main audio channel. (For instance, this involves the mixing of dialogue on top of dialogue which would require that both versions of dialogue be in time synchronization in order to avoid echo, or that the mixing level of the main audio program be reduced in level when the HI dialogue channel is active).

3.2.2.3 Program for the Visually Impaired

In order to serve the visually impaired, a VI service may be provided which contains a narrative of the visual program. The receiver would decode the VI service and the audio program, and reproduce both for the VI viewer. The VI viewer should have control over the relative volume of the VI service, and the channel from which it is reproduced. (For instance, it might be best mixed into one of the rear channels so as not to compete with the main frontal sounds, or available as a discrete output to feed headphones.)

3.3 Receiver Requirements

The ATV receiver should produce sound for any of the pre-defined coding modes that the programmer chooses to use. This does not imply that every receiver must be capable of fully decoding a 3/2 service;

only that it make sound from it. It is acceptable for a receiver to decode all modes into monophonic or two-channel stereophonic audio.

The receiver should be capable of decoding the 3/2, 3/0, 2/0 composite coded modes, and the high, medium, and low quality independent modes, into at least one listenable audio channel. In the case of a two-channel stereophonic program using two independently coded services, the receiver should be capable of decoding two independently coded services simultaneously.

If service is to be provided to the hearing or visually impaired, the ATV receiver should be capable of simultaneously decoding: one composite coded service (either 3/2, 3/0, or 2/0) and one independently coded service (main audio compositely coded and the HI or VI service independently coded); or three independently coded services (main stereophonic audio using two independent services plus the HI or VI service).

The receiver should also be capable of forming complete audio programs from multiple services as described in 3.2.2.

4. Ancillary Data Services

4.1 Captioning

The ATV system should provide a captioning system capable of delivering multiple versions of captions. Different versions of captions may be used to provide service in multiple languages, for the hearing impaired as well as the non-impaired. A minimum requirement on the captioning system should be that it allow three versions of captions: primary language, secondary language, and primary language for slow readers. A data rate sufficient to support this level of service should be allocable to the captioning service when captioning information is available. It should be possible to allocate additional data to the captioning service to support delivery of additional versions of captions (or subtitles). All ATV receivers should be able to decode and display captions. In addition, the captioning signal should be recordable on a consumer VCR.

4.2 Teletext

ATV should allow teletext as an optional service. The data rate required for teletext will depend on the amount of information to be provided and the refresh rate. Data may be allocated to teletext at the option of the programmer. The SVID will inform the receiver as to the teletext data rate, and the location of the teletext data within the overall data multiplex. Use of teletext data is receiver optional.

4.3 Program Guide for Channel

The program guide is an optional service. The program guide is intended to inform the viewer about the programming available on the particular ATV channel being viewed. The program guide service should be capable of delivering text accompanied by graphics. For the benefit of the viewer who is quickly scanning channels, six lines of text identifying the current and upcoming programs should be provided. This receiver scanning guide should be refreshed at least once per second so that a viewer scanning channels may receive current program information quickly after selecting an ATV channel. The data for a complete multi-page program guide may be interleaved with the receiver scanning guide data. This information is refreshed at a lower rate, and the viewer will have to remain on channel for a number of seconds to receive the complete program guide. Program guide information may be useful to assist viewer VCR's to record the correct program at the correct time.

In the case of a viewer scanning channels, the program guide data should be found quickly in order to minimize the delay in displaying the current program information. If an additional frequency agile tuner is available, either in the ATV receiver or at a cable headend, all available ATV channels may be scanned and the program guide information for all available channels combined to form a multi-channel program guide.

4.4 Conditional Access Control

Some applications of the ATV system will require data to be allocated to conditional access control. The required data capacity will depend on the size of the audience being served and the type of service being offered (i.e. pay-per-view or monthly subscription). There should be no fixed allocation of data to conditional access. Data capacity should be allocable to conditional access control at the option of the particular service provider. This document makes no recommendation as to the conditional access system or the data rate required to support a conditional access system.

4.5 Program and Source Identification (SID)

Program and source identification information may be delivered as an allocated data service, or simply as self contained descriptor information. This service is programmer optional.

4.6 Other

The ATV system should allow data to be allocated to other services. ATV receivers are not required to process data allocated to other services.

5. Example Data Rates

Data should be allocable. The data requirement for each service, and its location within the data multiplex should be indicated in the SVID. Data should always be allocated to the SVID, and its use is pre-defined.

1. Permanent allocation:
    a) Service Identification Data = (as needed)
    b) Captioning (when available) = (to be determined)

2. Pre-defined audio services:
    a) High Quality Audio Channel (1/0) = 128 k bits/sec
    b) Medium Quality Audio Channel (1/0) = 96 k bits/sec
    c) Low Quality Audio Channel (1/0) = 64 k bits/sec
    d) Five Channel Audio Program (3/2) = 300 to 400 k bits/sec
    e) Three Channel Audio Program (3/0) = 256 k bits/sec
    f) Two-Channel Audio Program (2/0) = 196 k bits/sec

3. Pre-defined Data Services:
    a) Program Guide = (to be determined)
    b) Program and Source ID = (to be determined)
    c) Additional Captioning = (as needed)
    d) Other = (to be determined)

4. Other Data Services:
    a) Teletext = (as needed)
    b) Conditional Access Control = (as needed)
    c) Other = (as needed)